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Overview of the 2014 Supplemental Federal Columbia River Power System Biological Opinion

NOAA FISHERIES WEST COAST REGION

This Overview is provided to introduce NOAA's thorough and lengthy decision document: the 2014 FCRPS Supplemental Biological Opinion. The Opinion and its supporting documents should be consulted for a complete understanding of the relevant evidence, issues, and determinations.

Background

In 2008, NOAA Fisheries issued a biological opinion for the operation and maintenance of the Federal Columbia River Power System (FCRPS). The 2008 FCRPS Biological Opinion describes a comprehensive set of actions to ensure that the operational effects of the FCRPS on 13 listed salmon and steelhead species and their critical habitat in the Columbia River Basin complies with section 7(a)(2) of the Endangered Species Act.[1] The suite of actions, called a Reasonable and Prudent Alternative (RPA), addresses and improves the factors limiting fish survival across all life stages to reduce or mitigate for the adverse effects of the hydropower system. Actions include, among other things, hydropower actions, such as flow and fish passage; estuary and tributary habitat improvements; and hatchery and predation management measures.

The actions are to be implemented from 2008 through the end of 2018. The RPA also includes a robust adaptive management framework designed to adjust implementation activities based on new scientific information. Monitoring and research assesses the RPA's effects, and adaptive management responds to new information by adjusting implementation to achieve the FCRPS BiOp's survival objectives. NOAA Fisheries and the FCRPS Action Agencies—the Bonneville Power Administration, U.S. Army Corps of Engineers, and Bureau of Reclamation—work closely with sovereign state and tribal governments to implement the FCRPS Biological Opinion through the development of implementation plans, annual progress reports, and multi-year comprehensive evaluations. New scientific information guides the implementation as it becomes available, along with the advice of regional, technical experts. This collaboration and adaptive management advances the protection of listed salmon and steelhead.

Following extensive review by the Administration, in 2009 NOAA Fisheries provided for more aggressive implementation of the RPA, improved monitoring, and contingency measures should fish abundance unexpectedly decline. In 2010, NOAA Fisheries re-examined and re-affirmed the 2008 conclusions in a supplemental biological opinion and modified the RPA. This 2014 Supplemental FCRPS Biological Opinion responds to a 2011 Court Remand Order. It evaluates the first five years of RPA implementation and the actions planned for the remaining five years, considering the best science currently available.

1 This 2014 Supplemental FCRPS BiOp also confirms analyses or includes new analyses for Southern Resident killer whales, North American green sturgeon, and eulachon.

Key elements of the 2014 Supplemental FCRPS Biological Opinion

In this 2014 Supplemental FCRPS Biological Opinion, NOAA Fisheries evaluated the Endangered Species Act (ESA) analyses and conclusions of the 2008 and 2010 FCRPS biological opinions, considering:

- The best scientific and commercial data available, relevant to the status of the listed species, environmental baseline, and cumulative effects;
- The effectiveness of RPA implementation to date, evaluating whether the RPA is being implemented as intended and its likelihood of producing the expected results; and
- The RPA actions targeted for implementation from 2014 through 2018, particularly focusing on tributary and estuary habitat, to assess whether the operation of the FCRPS, combined with the RPA, satisfies the substantive requirements of section 7(a)(2) of the ESA to avoid jeopardizing the continued existence of the species and adversely modifying their critical habitat.

New Information Considered in the 2014 Analysis

NOAA Fisheries examined updated information from currently available scientific reports and data indicating the biological status of the species. For example, NOAA Fisheries completed five-year status reviews for each of the species in 2011 and concluded that the listing status of all species was unchanged from the 2005 status review, on which the 2008/2010 FCRPS biological opinions relied. Additionally, when individual populations of Chinook and steelhead were evaluated relative to recovery criteria, the new five-year status review indicated that most populations had increased abundance, decreased productivity, and there was little or no change in spatial structure or diversity compared to population risk metrics at the time of the previous five-year review.

NOAA Fisheries determined that new information supports the 2008 FCRPS Biological Opinion's description of the range-wide status of the species and their critical habitats. In particular, NOAA Fisheries determined that the decreased productivity was an expected consequence of increased adult fish abundance. It also found that the effects of most factors influencing the environmental baseline remain similar to those considered in 2008. Increased environmental baseline effects are being addressed by enhanced RPA actions. Similarly, the 2008 analysis of cumulative effects remains accurate for this 2014 Supplemental FCRPS Biological Opinion.

RPA Implementation Progress and Effectiveness

NOAA Fisheries reviewed implementation progress described in the FCRPS Action Agencies' 2013 Comprehensive Evaluation to assess whether the RPA actions are occurring as intended in the 2008 FCRPS BiOp. The agency also evaluated the prospective actions described in the FCRPS Action Agencies' 2014 - 2018 Implementation Plan. NOAA Fisheries determined that the RPA is on track to achieve the effects identified in the 2008 FCRPS Biological Opinion, as necessary to ensure compliance with section 7(a)(2) of the ESA, though much work remains to be done through 2018.

Specifically, NOAA Fisheries found that the effects of the RPA actions will be as beneficial or, for 22 populations, more beneficial than anticipated in the 2008 FCRPS Biological Opinion. The higher survival estimates for these populations provide additional assurance that the required survival benefits will be achieved. Collectively, the best available scientific data continues to support NOAA Fisheries' conclusion that the RPA, as implemented and expected to be implemented through 2018, will avoid the likelihood of jeopardizing the continued existence of 13 listed salmon and steelhead species or destroying or adversely modifying their critical habitats.

Two components of the broader RPA program, identified below, illustrate NOAA Fisheries' findings regarding the sufficiency of the RPA, as well as NOAA Fisheries' conclusions reached in this 2014 Supplemental FCRPS Biological Opinion.

Tributary & Estuary Habitat Actions

The RPA tributary actions are designed to improve spawning and rearing habitat in the basin's interior. They include specific tributary habitat improvement actions for implementation from 2007 – 2009. For 2010 – 2018, the RPA required the FCRPS Action Agencies to implement a process to achieve specific habitat quality improvements, and associated survival improvements, for 56 populations. To achieve the improvements, the FCRPS Action Agencies' 2010-2013 Implementation Plan identified specific actions for implementation from 2010-2013, but did not specifically identify habitat actions after 2013. The 2014 - 2018 Implementation Plan responds directly to the Court's remand order by identifying specific actions for implementation through 2018 [See the Tributary Actions and Estuary Actions Sections of the 2014 - 2018 Implementation Plan on www.salmonrecovery.gov]. In this 2014 Supplemental FCRPS Biological

Opinion, NOAA Fisheries evaluated progress in implementing these projects to date and the likely effects of implementing the remaining habitat actions for the 2014 - 2018 period.

Similar to tributary habitat actions, the RPA includes projects to improve the survival of interior basin salmon and steelhead in the Columbia River estuary. The estuary program was based on the method developed by the Remand Workgroup and designed to address factors limiting survival as juvenile fish transition from the freshwater to marine environments. Based on guidance from the program's Expert Regional Technical Group, the program has evolved to focus on projects that reconnect the historical floodplain and side channels at large sites located near the mainstem Columbia. In this way, the estuary program is being adaptively managed to incorporate the results of scientific study to achieve the RPA objectives.

NOAA Fisheries' analysis concludes that both tributary and estuary habitat projects identified for implementation from 2014 through 2018 are sufficiently defined, can be implemented consistent with the purpose of the FCRPS, are within the FCRPS Action Agencies' legal authority and jurisdiction, and are economically and technically feasible. NOAA Fisheries further concludes that, when added to projects implemented since 2007, the habitat projects are reasonably certain to achieve the RPA's objectives, as identified in the 2008 FCRPS Biological Opinion.

Preliminary results from the monitoring and evaluation program provide evidence that the actions implemented to date in both the tributaries and estuary are correctly targeting degraded conditions and providing benefits to fish. In addition, the actions identified for implementation through 2018 contain sufficient detail and, in the case of the tributary habitat program, include identification of populations to benefit. The actions also identify type of work to be accomplished; limiting factors addressed; extent of area to be treated; volume of water or area of habitat to be protected; and location of work.

Both programs aim to protect and enhance Snake River spring/summer Chinook salmon, Upper Columbia River Chinook salmon, Snake River steelhead, Upper Columbia River steelhead, and Middle Columbia River steelhead and their critical habitat. Further, estuary actions are expected to benefit Snake River fall Chinook and sockeye salmon. Based on NOAA Fisheries' review, the best available scientific data indicates that the habitat actions are likely to have their intended effects and are properly considered and relied on as part of the broader FCRPS RPA program.

NOAA Fisheries' Determination

The 2008 FCRPS Biological Opinion, as supplemented in 2010, considered qualitative and quantitative information at the population, major population group, and species levels to determine whether the RPA was sufficient to avoid jeopardy. After reviewing the RPA's prospective actions aggregated with the environmental baseline and cumulative effects, the 2008 FCRPS Biological Opinion concluded that the listed species are likely to survive with an adequate potential for recovery. Therefore, the RPA, as amended, is not likely to jeopardize the continued existence of the listed species and destroy or adversely modify designated critical habitat.

Based on a thorough review of the best available scientific data and information, with additional project definition, analysis, and amended RPA actions NOAA Fisheries has recommended to the FCRPS Action Agencies, NOAA Fisheries concludes that the 2008 FCRPS Biological Opinion's analysis and conclusions, as supplemented in 2010, remain valid. The 2014 Supplemental FCRPS Biological Opinion concludes that the RPA, as amended, is sufficient and is not likely to jeopardize the continued existence of the listed species or destroy or adversely modify their critical habitat. Additional mitigation actions are therefore not necessary to satisfy the requirements of ESA section 7(a)(2).

For More Information

The 2014 Supplemental FCRPS Biological Opinion and accompanying documents are available at: http://www.westcoast.fisheries.noaa.gov/fish_passage/fcrps_opinion/federal_columbia_river_power_system.html

3.5.2 Terns and Cormorants

One of the assumptions in our 2008 BiOp analysis was that specific rates of predation estimated for the Base Period would continue into the future. However, as noted in Section 2.2.4, this underestimated the predation rates by double-crested cormorants in the estuary, which increased substantially in numbers during 2003–2009. As a result, the productivity of interior Columbia basin steelhead populations is about 3.6% lower than assumed for the Current Period in the 2008 BiOp analysis, and that of interior Columbia basin stream-type spring- and summer-run Chinook salmon and ocean-type SR fall Chinook salmon is about 1.1% lower than assumed.

Reducing the cormorant population in the Columbia River estuary back to the Base Period level is one way that a management plan might address this issue. Based on current average per capita consumption rates, maintaining the existing colony at about 5,661 pairs (range of 5,380 to 5,939)—a reduction of about 6,600 pairs, or 54%—would result in a continued steelhead consumption rate equivalent to that estimated during the Base Period (2.9%). Similarly, Base Period yearling Chinook consumption rates (1.1%) could be achieved by maintaining the existing colony at about 6,536 pairs (range of 6,221 to 6,848)—a reduction of about 5,500 pairs, or 47% (Appendix E).

The issue of compensatory predation mortality was raised during the comment period of this Supplemental Opinion. The idea of compensatory predation mortality would argue that at least some portion of the fish consumed by predators would have died from other factors subsequent to the predation event. As explained by the ISAB (2011), "losses to predation early in the life history might be compensated for by reduced losses during later life stages. Such compensation would be expected if predators selectively remove the most vulnerable individuals." The corollary is that reducing mortality caused by one predator may not translate directly into a corresponding increase in the rate of survival to adulthood because another species' predation rate may increase (e.g., because of a higher proportion of vulnerable fish remaining in its prey population). There is evidence that fish condition, size, and rearing history may affect the vulnerability of fish to double-crested cormorant predation (Hostetter et al. 2012), and it is likely that predation losses to avian predators is compensated somewhat due to these vulnerabilities. However, the magnitude of compensation associated with avian predation on juvenile salmonids in the Columbia basin is unknown (Lyons et al. 2011) and, as the ISAB (2011) points out, uncertain even for well-studied species:

> The pikeminnow removal program, initiated in 1990, appears to have progressively reduced mortality on juvenile salmonids by 25% after 5 to 6 years (Friesen and Ward 1999) and by 40% (CBFWA 2010) after 19 years (Figure C.3.2). To date, there is no evidence of compensation in predation, growth, or reproduction by surviving pikeminnow, or by other resident fish predators (CBFWA 2010).

The compensation argument is not, however, particularly important to the treatment of cormorant predation in this Supplemental opinion. Regardless of the magnitude of compensatory mortality associated with cormorant predation in the Columbia River, there is no evidence that it has changed over time. Therefore, if the cormorant population is reduced to its level during the Base Period (between 5,380 and 5,939 pairs), as described below in the modification to RPA Action 46, the impact of cormorant predation on salmonid survival (including any compensatory effects) should return to the same level that occurred during the Base Period.

Modified RPA Action 46 Double-crested Cormorant Predation Reduction

The FCRPS Action Agencies will develop a cormorant management plan (including necessary monitoring and research) and implement warranted actions to reduce cormorant predation in the estuary to Base Period levels (no more than 5,380 to 5,939 nesting pairs on East Sand Island).

Table 3.5-2. 2014 Supplemental Opinion modification to 2008/2010 RPA Action 46.

RPA Action No.	Description	Modified RPA language
46	Double-crested Cormorant Predation Reduction	The FCRPS Action Agencies will develop a cormorant management plan (including necessary monitoring and research) and implement warranted actions to reduce cormorant predation in the estuary to Base Period levels (no more than 5,380 to 5,939 nesting pairs on East Sand Island). Implementation Plans (and planned completion dates) □ Environmental Impact Statement (EIS)/Management Plan will be completed by late 2014 □ Record of Decision will be issued late 2014 □ Actions will begin to be implemented in 2015 Annual Progress Report □ Progress will be documented in the Action Agencies' annual implementation reports

The Corps is the lead agency on a draft EIS that will use NOAA Fisheries' survival gap and colony per capita analysis to develop objectives for double-crested cormorant management on East Sand Island. The USFWS, ODFW, WDFW, and USDA Wildlife Services are cooperating agencies to this EIS. The range of alternatives will cover lethal methods (shooting of individual birds, egg collection/nest destruction, etc.) and non-lethal methods (hazing, habitat modification, etc.) to reduce double-crested cormorant predation impacts to juvenile salmonids in the estuary.

The Corps is working with the states of Oregon and Washington regarding their concerns over dispersal of double-crested cormorants. The Corps, USFWS, and USDA Wildlife Services will each be issuing a record of decision after publication of the final EIS. After the record of decision is signed by the Corps (currently anticipated to occur in late 2014), implementation

of a management plan (the EIS preferred alternative) could take place before the 2015 breeding season. Adaptive management will be used to meet the goals of the EIS.

Managing natural resource damage by cormorants and associated conflicts on a local scale has been successfully implemented in the U. S. (double-crested cormorant), Europe, and Japan (Schultz 2012, Russell et al. 2012, Carss 2003, USFWS 2009). A recent example of a successful cormorant-damage management action includes a 2005 implementation at Leech Lake, Minnesota, by the Ojibwe Tribe, USDA Wildlife Services, and the state of Minnesota where loss of walleye to double-crested cormorants was determined to be a significant limiting factor to the local walleye population (Schultz 2012). This implementation was carried out under a Public Resource Depredation Order issued by the USFWS in 2003. According to the Minnesota Department of Natural Resources (Schultz 2010), the double-crested cormorant population at Leech Lake had grown to approximately 10,000 individual birds (fall count) in 2004. During the first five years of implementation (2005–2009), approximately 3,000 individual cormorants were removed from the lake annually. The program goal of approximately 2,000 fall count individuals was achieved in 2006 and had been maintained through 2009. Their preliminary evaluation results indicated that control actions reduced cormorant use of the lake by nearly 60%. The action was considered a success in helping to curb declining populations of walleye and contribute to record 2008–2009 walleye harvest rates. NOAA Fisheries recognizes that any similar management actions in the Columbia River basin will require that the Action Agencies first obtain the appropriate permits.

RPA Action 45 Caspian Tern Management Plan

The Action Agencies are currently implementing the Caspian Tern Management Plan, which they adopted in 2006. The plan calls for reductions in nesting habitat for Caspian terns at East Sand Island in the lower estuary, concurrent with the development of alternative nesting habitat elsewhere in the interior Northwest and along California coast (i.e., outside the Columbia River basin). To date, nine alternative nesting habitat islands totaling 8.3 acres have been constructed at interior locations, but no coastal sites have been developed. Predation (on eggs, chicks, and adults), lack of sufficient water, and limited food resources have plagued tern nesting success at several of these interior sites to the degree that a significant proportion of the alternative nesting habitat has not been available for nesting terns in any single year. These interior sites host approximately 1,500 pairs of Caspian terns at this time. Tern nesting habitat on East Sand Island has been reduced from 6 acres down to a current 1.58 acres, which has reduced the colony from a pre-management level of about 9,000 pairs to 6,000 to 6,500 pairs. However, this is short of the reduction to 3,500 to 4,000 pairs that was anticipated by the management plan and assessed in the 2008 BiOp's analysis. The reduction in tern numbers in the estuary has not translated to a similar reduction in salmonid smolt consumption, which remains similar to pre-implementation levels. Full realization of the anticipated smolt survival benefits is unlikely without additional habitat reduction on East

Sand Island, an action that may be limited by the availability of adequate alternative nesting habitat.

The 2008 BiOp (RPA Action 47) also required the Action Agencies to develop an inland avian predator management plan. This plan and an associated Environmental Assessment are expected in early 2014, which will be in time for limited implementation prior to the 2014 nesting season. At this time, only Caspian terns nesting on Goose Island in Potholes Reservoir and Crescent Island in the Columbia River are slated for management action (e.g., reductions in nesting habitat. Survival benefits to UCR steelhead and spring Chinook would begin to increase once nesting dissuasion actions begin in early 2014 (up to the currently estimated survival benefits of 11.4% and 3.0%, respectively, in subsequent years). Additional benefits to Upper Columbia and Snake River ESUs/DPSs may follow once alternative tern habitat can be developed outside the Columbia River basin and nesting dissuasion actions begin at Crescent Island (expected 3 to 4 years after the Goose Island management action).

Implementation of the Caspian Tern Management and Inland Avian Management plans will initiate movement among the various avian predator colonies in the basin. Monitoring at all the lower Snake and Columbia River dams (RPA Action 48) will help the adaptive management process by providing information on changes in avian predator activity in various parts of the hydropower system.

Modified RPA Action 48 Other Avian Deterrent Actions

RPA Action 48 is modified to clarify its scope and intent as follows in Table 3.5-3.

Table 3.5-3. 2014 Supplemental Opinion modification to 2008/2010 RPA Action 48.

RPA Action No.	Description	Modified RPA language
48	Other Avian Deterrent Actions	The Corps will monitor avian predator (terns, cormorants, and gulls) activity and continue to implement and improve avian deterrent programs at all lower Snake and Columbia River dams. This program will be coordinated through the Fish Passage Operations and Maintenance Team and included in the Fish Passage Plan (Section 3.5.2 Terns and Cormorants and IP RPA Action 48).

Summary

In summary, NOAA Fisheries has estimated that increasing numbers of double-crested cormorants in the estuary resulted in a Base-to-Current survival reduction of about 3.6% for steelhead and 1.1% for yearling Chinook (see Section 2.2.4.2 in this Supplemental Opinion). NOAA Fisheries has modified RPA Action 46, calling upon the Corps to reduce cormorant predation in the estuary to Base Period levels (no more than 5,380 to 5,939 nesting pairs on East Sand Island). The Corps is developing a management plan (and accompanying EIS) to address this issue with implementation of management actions estimated to begin in early 2015. Similar double-crested cormorant management actions in other parts of the U.S. have recently been implemented in a timely manner and have proven successful.

Implementation of the Caspian Tern Management Plan has had some success. Many acres of nesting habitat has been created, some of which is being used by about 1,500 pairs of terns. About 75% of the nesting habitat is no longer usable by Caspian terns at East Sand Island, and 3,000 to 3,500 fewer nesting pairs are preying on ESA-listed salmon at this time. However, the full anticipated benefit of the management plan has not yet been realized as the remaining birds are crowding into the available habitat, and smolt consumption rates remain at pre-management levels. Additional suitable nesting habitat is being sought by the Corps and USFWS to facilitate the movement of birds from East Sand Island to areas outside the Columbia River basin. Only about one acre of suitable habitat is needed, and current likely candidate locations include Federally owned and managed areas in lower San Francisco Bay, the Salish Sea of Puget Sound, and northern Great Salt Lake. It remains likely that suitable habitat will be found, allowing for full implementation of the management plan to occur, and for the reduction of Caspian terns (and associated losses of steelhead and Chinook smolts) to levels anticipated in the 2008 BiOp.

Finally, although the 2008 BiOp required the Action Agencies to develop an Inland Avian Predator Management Plan, no reductions in avian-caused mortality rates were assumed in the analysis. Actions expected in 2014 at Goose Island in Potholes Reservoir should substantially reduce mortality rates for UCR steelhead and UCR spring Chinook salmon (up to the currently estimated survival benefits of 11.4% and 3.0%, respectively). Additional benefits to Upper Columbia River and Snake River ESUs/DPSs may follow once alternative tern habitat can be developed outside the Columbia River basin and nesting dissuasion actions begin at Crescent Island.

3.5.3 Pinnipeds

As part of the predation management strategy, RPA Action 49 required the Corps to install and improve sea lion exclusion gates (SLEDs) at all adult fish ladder entrances at Bonneville Dam. In addition, the Corps agreed to take action in support of land and water-based harassment (hazing) efforts conducted by outside agencies to exclude sea lions or reduce the time they spend in the tailrace area immediately downstream of the dam.

Since 2010, SLED and Floating Orifice Gate barriers have been installed at all entrances of the Bonneville Dam adult fishways during the spring fish passage season (Jepson et al. 2011). These barriers are completely effective at preventing sea lions from entering the fishways of Bonneville Dam (Stansell et al. 2012). Current adult count and telemetry data indicates SLEDs are not having a substantial negative impact on successful salmonid passage (Jepson et al. 2011). Ongoing research in 2013 will provide further information on any delay or other potential impacts SLEDs may have on salmon passage. Consideration for the use of exclusion devices year-round may be necessary if Steller sea lions continue to be present in the fall and winter as a regular occurrence.

According to the Corps annual report, hazing in the Bonneville Dam tailrace included a combination of acoustic, visual, and non-lethal deterrents, including boat chasing, above-water pyrotechnics, rubber bullets, rubber buckshot, and beanbags fired from shotguns. Boat-based crews also used underwater percussive devices known as seal bombs outside of fish ladder entrance buffer zones. Dam-based and boat-based crews coordinated with Corps personnel to increase the effectiveness of hazing efforts. Dam-based hazing by USDA Wildlife Service agents began the first week in March and continued seven days per week through the end of May (Stansell et al. 2012).

Recent information indicates hazing is limited in its effectiveness at keeping sea lions outside of the tailrace, but hazing can be beneficial in reducing salmon consumption. While some measures appeared to be initially effective, they became less effective over time as pinnipeds learned to either tolerate or avoid the deterrence measure (Scordino 2010). Because adult salmonids tend to concentrate in tailraces in search of ladder entrances, efforts to limit the time pinnipeds spend in the tailrace is likely beneficial to salmon. Hazing at the current level of intensity slows the increase of predation (Stansell et al. 2011) and can be used to change behavior and temporarily move sea lions out of tailraces (Stansell et al. 2012). While the available information suggests intensive hazing may contribute to minor reductions in adult salmonid consumption, past research suggests hazing does not result in biologically significant reductions in salmon consumption when conducted in the absence of lethal take. Radio-telemetry studies conducted at Bonneville Dam indicate there is no substantial evidence that sea lion hazing efforts substantially delay or otherwise affect spring/summer Chinook (Jepson et al. 2011).

In summary, these actions continue to meet the goals of RPA Action 49 in supporting harassment efforts to reduce salmonid consumption and excluding pinnipeds from ladder

entrances at Bonneville Dam. Annual reports of observations and documentation of these efforts have been timely and effective. The information available at this time indicates these actions are beneficial in reducing consumption and not negatively affecting salmon and steelhead ESUs/DPSs, or pinniped populations. As part of the RPA, the Action Agencies will continue to support harassment and removal efforts, in addition to providing effective monitoring that satisfies the needs of the removal permits and successful implementation of the RPA.

3.5.4 Effects on Critical Habitat

As described above, the RPA includes actions to reduce the numbers of northern pikeminnows, Caspian terns, double-crested cormorants, and California sea lions that reduce the functioning of safe passage in juvenile and adult migration corridors. Further reductions in tern numbers and smolt consumption rates in the estuary will depend on the availability of adequate alternative nesting habitat. The Corps is developing an Environmental Impact Statement under NEPA for actions that would reduce cormorant consumption rates to the base levels assumed in the 2008 BiOp. Exclusion gates at the adult fish ladder entrances at Bonneville Dam have successfully reduced predation by California sea lions on spring Chinook and winter steelhead. Although predation continues to reduce the functioning of safe passage in the juvenile and adult migration corridors, RPA management efforts are improving these factors.

drawn by extrapolation from the documented increase in the number of predator-sized pikeminnow removed between the Base Period and the Current Period and the associated reduction in predation rates as estimated using the predation models (Friesen and Ward 1999), which assume that the juvenile salmon and steelhead preyed upon by northern pikeminnow would not have been subject to mortality from other sources (including inter- and intra-specific predation) on their route to the ocean (Porter et al. 2010). Uncertainties regarding the effects of monitoring on juvenile salmonids and the assumption that there is not compensatory mortality[56] that reduces the benefit of pikeminnow removal will continue to be investigated (see Section 3.8).

Avian Predation

New studies of cormorant predation since the 2008/2010 BiOps are described in Appendix E and are summarized here. The number of double-crested cormorants inhabiting colonies in the Columbia River estuary increased from an estimated 150 pairs in the early 1980s to over 6,000 pairs in the late 1990s. Numbers increased in the early 2000s but appear to have generally stabilized, varying between about 11,000 to 13,500 pairs during the past 10 years (Appendix E).[57] Double-crested cormorant consumption rates of juvenile salmon and steelhead increased throughout this period as well, peaking in 2006, when double-crested cormorants are estimated to have consumed about 13% of the interior Columbia basin juvenile steelhead and over 4% of the juvenile yearling Chinook salmon. Juvenile subyearling Chinook salmon from the Lower Columbia and Upper Willamette River ESUs are also consumed at relatively high rates—more likely similar to rates estimated for steelhead than for yearling Chinook salmon assuming they spend more time rearing in the estuary than do interior basin yearling Chinook smolts. In contrast, SR fall Chinook salmon, which are typically larger than fall Chinook juveniles from lower Columbia basin ESUs when they enter the estuary, are assumed to spend relatively little time rearing as juveniles in the vicinity of the cormorant colonies. For these reasons, NOAA Fisheries assumes that the yearling Chinook salmon estimate (–1.1%) is the most appropriate estimate to use as a Base-to-Current adjustment for SR fall Chinook salmon.

There is new information on cormorant consumption of sockeye salmon smolts in the estuary as well. Snake River Sockeye smolts were taken by cormorants at an estimated average annual rate of 1.3% during 1998 to 2012 (see Appendix E).

(b) (5)

NOAA Fisheries did not assume any compensatory mortality for predation by Caspian terns in the estuary in the 2008 BiOp and has no clear indication that the case would be different, or substantial, for predation by double-crested cormorants. Thus, the increasing loss of juvenile salmon and steelhead in the estuary due to cormorant predation has likely reduced the productivity (i.e., Recruit-per-Spawner estimates, Lambda estimates, etc.) of all Columbia River

[56] Mortality that would have occurred for another reason.
[57] Initial estimates for 2013 are 15,000 pairs of birds, an increase compared to the 2003–2012 10-year estimate (Collis 2014).

basin populations since the 1980s and, absent human intervention, would be expected to continue into the future.

Pinniped Predation

Pinniped Population Status

NOAA Fisheries (NMFS 2010a) previously summarized information relating to predation by pinnipeds and its likely effect on ESA-listed salmon and steelhead adults in the lower Columbia River (from the river's mouth upstream to Bonneville Dam). This section evaluates new information available since May 2010 to determine if NOAA Fisheries' previous conclusions regarding these effects can be reaffirmed or if the environmental baseline conditions have been substantially altered.

Lower Columbia River and Estuary

NOAA Fisheries removed the eastern DPS of Steller sea lions from the list of Endangered and Threatened Wildlife by a rule issued on November 4, 2013, determining the DPS to be recovered and no longer meeting the definition of a threatened species under the ESA (78 FR 66140).

This DPS has increased from an estimated 18,040 animals in 1979 to an estimated 63,488 animals in 2009 with an overall rate of increase of 4.3% per year. Most of the overall increase in population abundance was due to increases in the northern portion of the range in Southeast Alaska and British Columbia, but the smaller population in the south (Oregon and California) also increased in abundance (NMFS 2012b). Recent estimates of Steller sea lion abundance in the Columbia River estuary are lacking, however, increasing numbers throughout the eastern DPS indicate that numbers of Steller sea lions in the Columbia River estuary have likely also increased in recent years.

California sea lions in the U.S. are not listed as "endangered" or "threatened" under the ESA. Also, they are not listed as "depleted" or "strategic" under the Marine Mammal Protection Act because the human-caused mortality is less than the calculated potential biological removal and is considered insignificant (NMFS 2011d). The optimum sustainable population status of this population has not been formally determined, however, continued exponential growth indicated from the 2006 to 2008 pup counts suggests that the population is not yet at optimum sustainable population status (Scordino 2010). California sea lion pup counts continue to rise in recent years (Carretta et al. 2013) indicating recent management activities at FCRPS projects are not having substantial negative impacts on overall California sea lion population growth. Recent estimates of California sea lion abundance in the Columbia River estuary are lacking, however, increasing numbers throughout their range indicates that numbers of California sea lions in the Columbia River estuary have likely also increased in recent years.

The total effect of marine mammals on the productivity and abundance of Columbia River basin ESA-listed salmon populations is still uncertain, but it is clear that adult Chinook salmon contribute considerably to the diets of pinnipeds in the lower Columbia River and estuary. A

3.5.2 Terns and Cormorants

One of the assumptions in our 2008 BiOp analysis was that specific rates of predation estimated for the Base Period would continue into the future. However, as noted in Section 2.2.4, this underestimated the predation rates by double-crested cormorants in the estuary, which increased substantially in numbers during 2003–2009. As a result, the productivity of interior Columbia basin steelhead populations is about 3.6% lower than assumed for the Current Period in the 2008 BiOp analysis, and that of interior Columbia basin stream-type spring- and summer-run Chinook salmon and ocean-type SR fall Chinook salmon is about 1.1% lower than assumed.

Reducing the cormorant population in the Columbia River estuary back to the Base Period level is one way that a management plan might address this issue. Based on current average per capita consumption rates, maintaining the existing colony at about 5,661 pairs (range of 5,380 to 5,939)—a reduction of about 6,600 pairs, or 54%—would result in a continued steelhead consumption rate equivalent to that estimated during the Base Period (2.9%). Similarly, Base Period yearling Chinook consumption rates (1.1%) could be achieved by maintaining the existing colony at about 6,536 pairs (range of 6,221 to 6,848)—a reduction of about 5,500 pairs, or 47% (Appendix E).

The issue of compensatory predation mortality was raised during the comment period of this Supplemental Opinion. The idea of compensatory predation mortality would argue that at least some portion of the fish consumed by predators would have died from other factors subsequent to the predation event. As explained by the ISAB (2011), "losses to predation early in the life history might be compensated for by reduced losses during later life stages. Such compensation would be expected if predators selectively remove the most vulnerable individuals." The corollary is that reducing mortality caused by one predator may not translate directly into a corresponding increase in the rate of survival to adulthood because another species' predation rate may increase (e.g., because of a higher proportion of vulnerable fish remaining in its prey population). There is evidence that fish condition, size, and rearing history may affect the vulnerability of fish to double-crested cormorant predation (Hostetter et al. 2012), and it is likely that predation losses to avian predators is compensated somewhat due to these vulnerabilities. However, the magnitude of compensation associated with avian predation on juvenile salmonids in the Columbia basin is unknown (Lyons et al. 2011) and, as the ISAB (2011) points out, uncertain even for well-studied species:

> The pikeminnow removal program, initiated in 1990, appears to have progressively reduced mortality on juvenile salmonids by 25% after 5 to 6 years (Friesen and Ward 1999) and by 40% (CBFWA 2010) after 19 years (Figure C.3.2). To date, there is no evidence of compensation in predation, growth, or reproduction by surviving pikeminnow, or by other resident fish predators (CBFWA 2010).

The compensation argument is not, however, particularly important to the treatment of cormorant predation in this Supplemental opinion. Regardless of the magnitude of compensatory mortality associated with cormorant predation in the Columbia River, there is no evidence that it has changed over time. Therefore, if the cormorant population is reduced to its level during the Base Period (between 5,380 and 5,939 pairs), as described below in the modification to RPA Action 46, the impact of cormorant predation on salmonid survival (including any compensatory effects) should return to the same level that occurred during the Base Period.

Modified RPA Action 46 Double-crested Cormorant Predation Reduction

The FCRPS Action Agencies will develop a cormorant management plan (including necessary monitoring and research) and implement warranted actions to reduce cormorant predation in the estuary to Base Period levels (no more than 5,380 to 5,939 nesting pairs on East Sand Island).

Table 3.5-2. 2014 Supplemental Opinion modification to 2008/2010 RPA Action 46.

RPA Action No.	Description	Modified RPA language
46	Double-crested Cormorant Predation Reduction	The FCRPS Action Agencies will develop a cormorant management plan (including necessary monitoring and research) and implement warranted actions to reduce cormorant predation in the estuary to Base Period levels (no more than 5,380 to 5,939 nesting pairs on East Sand Island). Implementation Plans (and planned completion dates) □ Environmental Impact Statement (EIS)/Management Plan will be completed by late 2014 □ Record of Decision will be issued late 2014 □ Actions will begin to be implemented in 2015 Annual Progress Report □ Progress will be documented in the Action Agencies' annual implementation reports

The Corps is the lead agency on a draft EIS that will use NOAA Fisheries' survival gap and colony per capita analysis to develop objectives for double-crested cormorant management on East Sand Island. The USFWS, ODFW, WDFW, and USDA Wildlife Services are cooperating agencies to this EIS. The range of alternatives will cover lethal methods (shooting of individual birds, egg collection/nest destruction, etc.) and non-lethal methods (hazing, habitat modification, etc.) to reduce double-crested cormorant predation impacts to juvenile salmonids in the estuary.

The Corps is working with the states of Oregon and Washington regarding their concerns over dispersal of double-crested cormorants. The Corps, USFWS, and USDA Wildlife Services will each be issuing a record of decision after publication of the final EIS. After the record of decision is signed by the Corps (currently anticipated to occur in late 2014), implementation

of a management plan (the EIS preferred alternative) could take place before the 2015 breeding season. Adaptive management will be used to meet the goals of the EIS.

Managing natural resource damage by cormorants and associated conflicts on a local scale has been successfully implemented in the U. S. (double-crested cormorant), Europe, and Japan (Schultz 2012, Russell et al. 2012, Carss 2003, USFWS 2009). A recent example of a successful cormorant-damage management action includes a 2005 implementation at Leech Lake, Minnesota, by the Ojibwe Tribe, USDA Wildlife Services, and the state of Minnesota where loss of walleye to double-crested cormorants was determined to be a significant limiting factor to the local walleye population (Schultz 2012). This implementation was carried out under a Public Resource Depredation Order issued by the USFWS in 2003. According to the Minnesota Department of Natural Resources (Schultz 2010), the double-crested cormorant population at Leech Lake had grown to approximately 10,000 individual birds (fall count) in 2004. During the first five years of implementation (2005–2009), approximately 3,000 individual cormorants were removed from the lake annually. The program goal of approximately 2,000 fall count individuals was achieved in 2006 and had been maintained through 2009. Their preliminary evaluation results indicated that control actions reduced cormorant use of the lake by nearly 60%. The action was considered a success in helping to curb declining populations of walleye and contribute to record 2008–2009 walleye harvest rates. NOAA Fisheries recognizes that any similar management actions in the Columbia River basin will require that the Action Agencies first obtain the appropriate permits.

RPA Action 45 Caspian Tern Management Plan

The Action Agencies are currently implementing the Caspian Tern Management Plan, which they adopted in 2006. The plan calls for reductions in nesting habitat for Caspian terns at East Sand Island in the lower estuary, concurrent with the development of alternative nesting habitat elsewhere in the interior Northwest and along California coast (i.e., outside the Columbia River basin). To date, nine alternative nesting habitat islands totaling 8.3 acres have been constructed at interior locations, but no coastal sites have been developed. Predation (on eggs, chicks, and adults), lack of sufficient water, and limited food resources have plagued tern nesting success at several of these interior sites to the degree that a significant proportion of the alternative nesting habitat has not been available for nesting terns in any single year. These interior sites host approximately 1,500 pairs of Caspian terns at this time. Tern nesting habitat on East Sand Island has been reduced from 6 acres down to a current 1.58 acres, which has reduced the colony from a pre-management level of about 9,000 pairs to 6,000 to 6,500 pairs. However, this is short of the reduction to 3,500 to 4,000 pairs that was anticipated by the management plan and assessed in the 2008 BiOp's analysis. The reduction in tern numbers in the estuary has not translated to a similar reduction in salmonid smolt consumption, which remains similar to pre-implementation levels. Full realization of the anticipated smolt survival benefits is unlikely without additional habitat reduction on East

Sand Island, an action that may be limited by the availability of adequate alternative nesting habitat.

The 2008 BiOp (RPA Action 47) also required the Action Agencies to develop an inland avian predator management plan. This plan and an associated Environmental Assessment are expected in early 2014, which will be in time for limited implementation prior to the 2014 nesting season. At this time, only Caspian terns nesting on Goose Island in Potholes Reservoir and Crescent Island in the Columbia River are slated for management action (e.g., reductions in nesting habitat. Survival benefits to UCR steelhead and spring Chinook would begin to increase once nesting dissuasion actions begin in early 2014 (up to the currently estimated survival benefits of 11.4% and 3.0%, respectively, in subsequent years). Additional benefits to Upper Columbia and Snake River ESUs/DPSs may follow once alternative tern habitat can be developed outside the Columbia River basin and nesting dissuasion actions begin at Crescent Island (expected 3 to 4 years after the Goose Island management action).

Implementation of the Caspian Tern Management and Inland Avian Management plans will initiate movement among the various avian predator colonies in the basin. Monitoring at all the lower Snake and Columbia River dams (RPA Action 48) will help the adaptive management process by providing information on changes in avian predator activity in various parts of the hydropower system.

Modified RPA Action 48 Other Avian Deterrent Actions

RPA Action 48 is modified to clarify its scope and intent as follows in Table 3.5-3.

Table 3.5-3. 2014 Supplemental Opinion modification to 2008/2010 RPA Action 48.

RPA Action No.	Description	Modified RPA language
48	Other Avian Deterrent Actions	The Corps will monitor avian predator (terns, cormorants, and gulls) activity and continue to implement and improve avian deterrent programs at all lower Snake and Columbia River dams. This program will be coordinated through the Fish Passage Operations and Maintenance Team and included in the Fish Passage Plan (Section 3.5.2 Terns and Cormorants and IP RPA Action 48).

Summary

In summary, NOAA Fisheries has estimated that increasing numbers of double-crested cormorants in the estuary resulted in a Base-to-Current survival reduction of about 3.6% for steelhead and 1.1% for yearling Chinook (see Section 2.2.4.2 in this Supplemental Opinion). NOAA Fisheries has modified RPA Action 46, calling upon the Corps to reduce cormorant predation in the estuary to Base Period levels (no more than 5,380 to 5,939 nesting pairs on East Sand Island). The Corps is developing a management plan (and accompanying EIS) to address this issue with implementation of management actions estimated to begin in early 2015. Similar double-crested cormorant management actions in other parts of the U.S. have recently been implemented in a timely manner and have proven successful.

Implementation of the Caspian Tern Management Plan has had some success. Many acres of nesting habitat has been created, some of which is being used by about 1,500 pairs of terns. About 75% of the nesting habitat is no longer usable by Caspian terns at East Sand Island, and 3,000 to 3,500 fewer nesting pairs are preying on ESA-listed salmon at this time. However, the full anticipated benefit of the management plan has not yet been realized as the remaining birds are crowding into the available habitat, and smolt consumption rates remain at pre-management levels. Additional suitable nesting habitat is being sought by the Corps and USFWS to facilitate the movement of birds from East Sand Island to areas outside the Columbia River basin. Only about one acre of suitable habitat is needed, and current likely candidate locations include Federally owned and managed areas in lower San Francisco Bay, the Salish Sea of Puget Sound, and northern Great Salt Lake. It remains likely that suitable habitat will be found, allowing for full implementation of the management plan to occur, and for the reduction of Caspian terns (and associated losses of steelhead and Chinook smolts) to levels anticipated in the 2008 BiOp.

Finally, although the 2008 BiOp required the Action Agencies to develop an Inland Avian Predator Management Plan, no reductions in avian-caused mortality rates were assumed in the analysis. Actions expected in 2014 at Goose Island in Potholes Reservoir should substantially reduce mortality rates for UCR steelhead and UCR spring Chinook salmon (up to the currently estimated survival benefits of 11.4% and 3.0%, respectively). Additional benefits to Upper Columbia River and Snake River ESUs/DPSs may follow once alternative tern habitat can be developed outside the Columbia River basin and nesting dissuasion actions begin at Crescent Island.

3.10.4 Effects of Predation RPA Actions on Lower Columbia Basin Salmon and Steelhead

NOAA Fisheries has modified RPA Action 46, calling upon the Corps to reduce cormorant predation in the estuary to Base Period levels (no more than 5,380 to 5,939 nesting pairs on East Sand Island). The Corps is developing a management plan (and accompanying Environmental Impact Statement) to address this issue with implementation of management actions estimated to begin in early 2015.

3.10.5 Effects of the RPA RME Program on Lower Columbia Basin Salmon and Steelhead

Numbers of CR chum salmon, LCR and UWR Chinook salmon, LCR coho salmon, and LCR and UWR steelhead estimated to be handled as a result of RPA RME activities are shown in Table 38.1. In each case the incidental mortality of these fish is likely to be less than 1% of estimated 2008–2012 run sizes. These effects are small and are consistent with our estimates of the effects of RME in the 2008 BiOp.

3.10.6 Effects of RPA Actions to Address Effects of Climate Change

The ISAB recommended climate change adaptation actions in the estuary and mainstem Columbia River such as removal of levees or dikes to restore floodplain connectivity and tidal influence, restoring side channel habitat, and replanting and restoring riparian and wetland habitat along the mainstem (Section 3.9.3). These habitat actions will reduce impacts of climate change on lower Columbia basin species as well as those from interior Columbia ESUs and DPSs. Relevant implementation to date includes:

The Corps' study to identify the use and location of thermal refugia for adult steelhead and Chinook salmon in the lower Columbia River (USACE 2013b)

Action Agency estuary habitat actions that target the restoration of natural ecosystem processes, especially hydrologic reconnections

The ongoing pilot study to evaluate whether estuary habitat actions could incorporate additional elements to help maintain the habitat functions through time

The hydrodynamic numerical model of the Columbia River estuary and plume that can help the Action Agencies project climate-change related effects of the changing ocean environment on the Columbia River estuary

As described in Section 3.9.6, NOAA Fisheries continues to conclude that sufficient actions consistent with the ISAB's (2007b) recommendations for responses to climate change have been included in the RPA and that these are being implemented by the Action Agencies as planned. This applies equally to the interior and lower Columbia basin species.

8.2 Effect of the Take

In Section 4, *Conclusions for Salmon and Steelhead*, NOAA Fisheries determined that the level of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat when the RPA is implemented.

8.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" are nondiscretionary measures to minimize the amount or extent of incidental take (50 C.F.R. 402.02). The Reasonable and Prudent Measures set forth in Section 14.4 of the 2008 BiOp remain in effect.

8.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and the Action Agencies (or their contractors) must comply with them to implement the reasonable and prudent measures (50 C.F.R. 402.14). The Action Agencies (or their contractors) have a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this incidental take statement (50 C.F.R. 402.14). If the following terms and conditions are not complied with, the protective coverage of section 7(o)(2) will likely lapse.

> The Terms and Conditions set forth in Section 14.5 of the 2008 FCRPS BiOp remain in effect.

9 Supplemental Conservation Recommendations for Salmon and Steelhead

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measres to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 C.F.R. 402.02). This section supplements, without replacing, the Conservation Recommendations listed in Chapter 13 of the 2008 BiOp.

Conservation Recommendation 1

During the remainder of the FCRPS Biological Opinion, the FCRPS Action Agencies should work with NOAA Fisheries, regional co-managers, and the NPCC to assess additional actions within their authorities that could contribute further to the recovery of salmon and steelhead in the following subject areas:

Hydropower system operations and configurations,

Hatchery operations and configurations,

Habitat protection and improvement, and

Predator management.